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AUTHOR Waugh, Michael L.
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ABSTRACT

Several directions for potential research efforts in the field of computer-based education (CBE) are discussed. (For the purposes of this paper, CBE is defined as any use of computers to promote learning with no intended inference as to the specific nature or organization of the educational application under discussion.) Efforts should be directed at examining: (1) CBE effects on student achievement in all subject areas, focusing on such variables as mode of computer use (tutorial or simulation), nature of computer involvement (computer-assisted instruction or computer-managed instruction, substitute for or supplement to instruction), student characteristics, and design of instructional materials; (2) instructional design and motivational appeal of CBE materials and how they may influence student achievement and attitudes; (3) the relationship between instructional design of CAI and the sex and achievement of students; (4) CBE and the learning of science process skills and concepts; (5) effects of CBE experiences on reading and verbal communication skills; and (6) effects of LOGO and computer programming skills on logical thinking processes and problem-solving skills. It is suggested that these and other areas be examined soon in order to maximize the benefits and minimize the disappointments associated with the evolution of CBE. (JN)

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Proposed Directions for Research in Computer-Based Education

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Michael L. Waugh
Department of Secondary Education
Georgia Southern College
Statesboro, Georgia 30460

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Proposed Directions for Research in Computer-Based Education

The purpose of this paper is to discuss several directions for potential research efforts in the field of CBE. Huntington (1981) describes CBE programs as computer-assisted instruction (CAI) materials managed by computer-managed instruction (CMI) systems. This description is a broad definition of CBE since the various educational applications for computers fall under the generally accepted rubric of CAI, and these applications employ a wide range of data acquisition and reporting capabilities. However, as used throughout this paper, computer-based education is simply defined as any use of computers to promote learning with no intended inference as to the specific nature or organization of the educational application under discussion.

Several important findings have emerged from CBE research. Student achievement and attitudes are generally improved as a result of exposure to CBE experiences and this improvement can be accomplished in less time than would be required through traditional instruction (Edwards, Norten, Taylor, Van Dusseldorp and Weiss, 1974; Kulik, Kulik and Cohen, 1980; Kulik, Bangert and Williams, 1983). However, while these findings were obtained from a wide diversity of CBE studies, an important point for consideration is that the majority of these studies were conducted in the subject of mathematics through the CAI modes of drill-and-practice and tutorial. Thus, more research in subject areas other than mathematics and concerning other modes of CAI, as well as CMI systems will be required to clearly delineate the overall impact of the growing diversity of CBE experiences.

More research must be accomplished in all subject disciplines regarding the effectiveness of various modes of CAI and CMI systems on student achievement. This research is necessary not only to further current knowledge

concerning the benefits of CAI drill-and-practice and tutorial programs but, more importantly, to establish the potential impact of modes such as simulation and problem solving. Studies concerned with student achievement questions should consider variables such as the following:

1) mode of computer use (i.e., tutorial, simulation, etc.);

2) nature of computer involvement (i.e., CAI, CMI, substitute for or supplement to instruction);

3) student characteristics (i.e., aptitude, attitudes, personality type, sex, age); and,

4) design of instructional materials (i.e., graphics, motivational aspects).

A definite need exists for research concerning the instructional design and motivational appeal of CBE materials. Atkinson (1984) questions how the instructional design of a CAI program influences it's effectiveness. This relationship has received little attention and requires further research if we are to establish how to most effectively individualize instruction. Lepper (1985) questions how differences in the motivational appeal of CBE materials might influence their instructional effectiveness. A study by Mathis, Smith and Hansen (1970) found that students who performed well during CAI instruction possessed more favorable attitudes toward CAI than did those students who performed poorly. Anderson, Kulhavy and Andre (1971) studied feedback procedures using a computer-based programmed instruction lesson, and found that students who received knowledge of the correct response after each frame in the lesson performed significantly better on the criterion-based posttest. The motivation and instructional design questions have arisen from research findings such as those cited above and imply that the structure and motivational appeal of selected CBE experiences may influence student achievement and attitudes. However, more work must be done in both of these

areas before major improvements in the quality and effectiveness of CBE materials are likely to result.

Studies concerning the question of social equity are also needed. For example, studies are needed which examine the relationship between the instructional design of CAI and the sex and achievement of students. Edwards, et al. (1974) reported that "boys tend to gain more from CAI than girls" (p. 124). In their meta-analysis of mathematics achievement, Burns and Bozeman (1981) found that supplementary drill-and-practice CAI was more effective for middle school boys than girls. In a study of college astronomy students, Wooley (1978) employed CAI treatments which involved variations in type of feedback. He found that females consistently scored lower than males on a variety of achievement measures, and that females scored significantly lower than males on a posttest of mathematics ability and on a CAI attitude instrument. Lepper (1985) describes the current preponderance of "supposedly motivating educational activities" for microcomputers as "simply more appealing to boys" (p. 15).

While something about the essence of certain CBE experiences may be less beneficial for girls than boys, Lepper (1985) infers that the key factor may simply be motivation which is subject to selective influence. Thus, work must be done to determine the nature of the motivational characteristics of specific CBE experiences and how these might selectively influence the achievement of any sub-population of students.

A complete agenda for future CBE research endeavors would be virtually impossible to compile due to the great variety of potentially beneficial educational applications of computers. However, several potential CBE research topic areas are listed below. Studies to determine the effects of:

1) Computer-assisted laboratory exercises/simulations on learning science process skills and concepts;

2) Computer-assisted testing on achievement;

3) Computer-managed instructional systems on achievement, attitudes, learning time;

4) Interactive videodisk tutorials or simulations on achievement, attitudes and learning time;

5) LOGO and computer programming skills on logical thinking processes and problem solving skills;

6) Data base access and utilization on research skills;

7) Word processing on writing ability, style, mechanics, spelling;

8) CBE experiences on reading and verbal communication skills; and,

9) highly motivating CBE experiences on the ability of students to profit from subsequent learning experiences taught through traditional methodologies;

would all serve to broaden our understanding of the nature of the impact of CBE, and assist in determining the most effective CBE applications. Yet, studies comparing student achievement in one mode of CAI against another would often be inappropriate as, for example, where the nature of drill-and-practice is fundamentally different from that of simulation. Directly comparing many CBE experiences based on their overall influence on student achievement would be like comparing apples and oranges. Therefore, comparisons of this nature must be made with caution. Many CBE experiences may be compared though, on variables such as learning time, and relative achievement effects within different sub-populations of students.

This paper has attempted to offer suggestions concerning possible directions for future research efforts in CBE. Lepper (1985) forecasts that in the very near future, the widespread distribution of microcomputers in our society will prevent researchers from accomplishing certain types of research, for they will be unable to find uncontaminated control groups. He is concerned, for example, about the ways in which the proliferation of

microcomputers will affect the process of social development in children. Indeed, many important questions concerning the nature of the impact of CBE on our society must be answered soon if we are to maximize the benefits and minimize the disappointments associated with the evolution of CBE. We should move quickly on research to determine which specific CBE applications are most appropriate for particular students in specific subject areas, and how to design effective CBE instructional materials to maximize student learning.

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